[19] State Intellectual Property Office
of the People's Republic of China

[51] Int. Cl[7]
B66B 5/02

[12] Published Specification of Invention Patent Application

[21] Appl. No. 01807220.8

[43] Publication date: May 21, 2003

[11] Publication No.: CN 1419518A

[22] Filing date: 3/21/2001
[21] Appl. No.: 01807220.8
[30] Priority
[32] 3/31/2000 **[33]** EP **[31]** 00810272.5
[86] International appl.: PCT/CH01/00175 3/21/2001
[87] International publication: WO01/74703 Germany 10/11/2001
[85] Date application entered national phase: 9/26/2002

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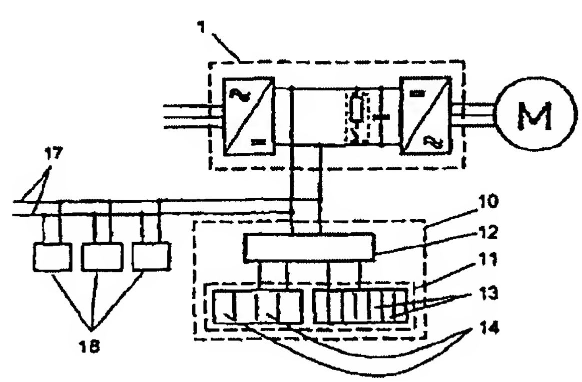
Claims 2 pages; Description 7 pages, Drawings 2 pages

[54] Title of invention: Emergency power supply device for elevator equipment

[57] Abstract

The purpose of the emergency power supply device for elevator equipment having electrically powered devices lies in providing crossover during momentary AC voltage drops or interruptions and, while the elevator is traveling, in ensuring the supply of power to all elevator equipment components necessary to emergency operation until the elevator cab reaches a floor. The energy-storing unit (11) which is used as a storage medium for the above purpose is either only a capacitor, being a supercapacitor (13), or an assembly consisting of a supercapacitor (13) and an electrochemical battery (14).



ISSN1008-4274

Published by Intellectual Property Rights Publishing House

1. An emergency power supply device (10) for elevator equipment having electrically-powered devices, having an electrical energy storage unit, said energy storage unit supplying electrical power to all elevator equipment electrical components that take part in emergency operation at least until the elevator cab reaches a floor, providing crossover for momentary alternating-current voltage drops or interruptions and ensuring emergency operation while the elevator is traveling, characterized by the fact that an energy storage unit (11) comprises a supercapacitor (13)-type capacitor.

2. The device described according to claim 1, characterized by the fact that the energy storage unit (11), comprises only a supercapacitor (13) as its storage medium, or comprises a supercapacitor (13) and electrochemical battery (14) assembly.

3. The device described according to claim 1 or 2, characterized by the fact that said device is linked to a frequency converter (1), the frequency converter being used to govern the travel speed of the elevator.

4. The device described according to claim 3, characterized by the fact that the energy storage unit (11) receives a floating charge from a direct-current voltage intermediate circuit, and when necessary said energy storage unit (11) feeds electrical energy to the direct-current voltage intermediate circuit (5), a power flow governor (12) connected therebetween regulating the different voltage levels between the direct-current voltage intermediate circuit (5) and the energy storage unit (11).

5. The device described according to claim 4, characterized by the fact that said device, by means of the direct-current voltage intermediate circuit of the frequency converter, at least provides an emergency current to those electrical components that can ensure adequate emergency operation and during normal operation said direct-current voltage intermediate circuit (5) also feeds electric power to these components (18).

6. A method of supplying emergency electric power to elevator equipment having electrically-powered devices, whereby electric power is supplied while the elevator is traveling to components (18) vital to emergency operation during a power outage or a momentary alternating-current voltage drop or interruption at least until the elevator cab reaches a floor, characterized by the fact that at least a part of the emergency power supply/energy is stored in a storage medium in the form of a supercapacitor (13).

7. The method as described according to claim 6, characterized by the fact that the emergency power supply device (10) is put into operation without interruption during a power outage or a momentary alternating-current voltage drop or interruption.

8. The method as described in claim 6 or 7, characterized by the fact that one, single emergency power supply (10) is used to supply electric power to a plurality of elevators.

9. The method as described in claim 6 or 7, characterized by the fact that the emergency power supply device (10) is permanently installed in a building or is installed on elevator equipment having an integrated driving device and moving in tandem with the latter.

10. The method as described in any one of claims 6 through 9, characterized by the fact that the emergency supply device (10) has an energy storage unit (11), said energy storage unit being continuously connected through a power flow regulator (12) to a direct-current voltage intermediate circuit (5) of a frequency convertor (1), and its being designed such that, in addition to serving as an emergency power supply storage device, it is used to reduce the connection power of the power supply during normal elevator operation, wherein the energy storage unit (11) stores energy from the power grid during low-power consumption phases of the drive system, recovers energy in the braking process, and outputs energy to the drive system during high energy consumption.

Emergency Power Supply Device for Elevator Equipment

The present invention relates to an emergency power supply device for elevator equipment having electrically-powered devices. Said emergency power supply device has an electrical energy storage unit, and said energy storage unit provides crossover for momentary alternating-current voltage drops or interruptions and ensures emergency operation while the elevator is traveling. This energy storage unit supplies electrical power to all electrical components of elevator equipment that take part in emergency operation at least until the elevator cab reaches a floor.

Electrical machinery is generally used to drive passenger and freight elevators. Various kinds of principles to convey lifting force may be employed by such machinery. The most common embodiment entails a rotating electric motor that directly, or by means of a transmission mechanism acting on a main drive wheel, drives the load-carrying cable. The elevator cab is suspended from one end of said load-carrying cable, and a counterweight is suspended from the other end. It is the latter that is moved. In another embodiment, a rotating electric motor drives a hydraulic pump. Said hydraulic pump controls one or multiple hydraulic cylinders primarily by means of pressurized fluid. Said hydraulic cylinders drive the elevator cab directly or by means of cables. Based on another driving principle, a linear electric motor is used to lift or lower the elevator cab or its counterweight, which is connected to it by a cable. In modern elevator equipment, the speed of the elevator cab is largely governed by adjustments to the frequency of the alternating current delivered to the drive/AC motor.

Generally, what all these driving devices share in common is the fact that they obtain energy from the power grid, which is sometimes subject to momentary voltage drops or interruptions and to long-term power outages. In equipment that lacks emergency power supply devices, these power supply problems will create inconveniences for passengers. In such cases, an elevator cab stops between the stopping points of two floors, and the passengers are unable to leave the cab without help from outside the elevator. To avoid such situations, some elevator equipment is outfitted with emergency power supply devices. Said emergency power supply devices include an energy storage device, which uses stored energy to enable the driving device to transport the elevator cab to the next floor and to keep elevator-related systems in operation until the next floor.

Such an emergency power supply device is disclosed in US 5,058,710. If a power outage or a momentary AC voltage drop or interruption occurs while the elevator is moving, said emergency power supply device feeds electric power to a driving motor and to other electrical components vital to emergency operation until the elevator cab reaches the next floor. During normal operation, the battery which serves as the energy storage unit receives a floating charge from a charger. In addition, when there is a power

outage, its electrodes are connected through the contacts of a power supply monitoring relay to a DC voltage intermediate circuit of a frequency converter that feeds power to the driving motor.

An emergency power supply device which serves as an independent energy storage device and that uses an electrochemical battery as its battery has the following major drawbacks: When applied, i.e. when the elevator driving device must use the energy storage device during a power outage to maintain uninterrupted operation and to transport a fully-loaded elevator cab at least to the next floor in the original travel direction and speed, the energy storage device must achieve relatively large discharge power in a relatively short period of time. An electrochemical battery has relatively low power density (roughly 300 W/kg), and when applied to a high-power elevator, will weigh hundreds of kilograms. Moreover, in equipment where a battery must regularly provide such power, battery life will be drastically shortened. And since the charging power that batteries allow is much smaller than their output power, a linkage problem will occur. That is, when power returns, and the elevator can operate again, it becomes necessary to wait a rather long period of time while charging takes places. Otherwise, there is the risk that, should another power outage occur, the elevator cab will stop between two floors. Another drawback to applying batteries to elevator equipment is the need to carry out periodic monitoring and maintenance. In addition, batteries leave many toxic wastes when they reach the end of their service lives.

An object of the present invention lies in providing an emergency power supply device for elevator equipment of the above-described forms while avoiding the above-described defects. Said emergency power supply can, when power outages and momentary AC voltage drops or interruptions occur rather frequently, provide the large amount of electrical power needed for driving and controlling the elevator cab so that it can continue at a constant speed to the next floor at least. The power supply is ready for use again a few seconds after power has been restored following a period when the emergency power supply was in use. Its service life is several times longer than the life of an electrochemical battery used under the same operating conditions.

The object of the present invention is achieved through the features provided in the independent claims 1 and 6 of the present invention. According to claim 1, an emergency power supply device for elevator equipment having electrically-powered devices has an electrical storage unit, characterized by the fact that said storage unit comprises a capacitor in the form of a supercapacitor. According to claim 6, an emergency power supply method for elevator equipment having electrically-powered devices is characterized by the fact that at least a part of the emergency power supply/energy is stored in the form of a supercapacitor in storage media.

The present invention is founded on the following concepts. The energy storage device employs a new type of capacitor, namely a supercapacitor instead of a battery or in combination with a battery. Generally, multiple supercapacitors are used in series, and the total capacity of capacitors in series is several farads; their voltage can reach several hundred volts. A supercapacitor is a double-level capacitor,

in which the electrodes are coated with activated charcoal. Thus, each gram of charcoal has thousands of square meters of effective surface, and the two electrodes are separated by tiny gaps on the order of nanometers. Because of these characteristics, these commercially available energy storage devices have especially large capacitance.

Supercapacitors, when applied as the energy storage medium for elevator equipment emergency power supply devices, have the following advantages:

A large number of charge-discharge cycles. (At present, supercapacitor power density is roughly 10-15 kW/kg. The power density of current batteries is roughly 300-1,000 W/kg.) Therefore, one energy storage unit that is at least 10 times lighter can achieve uninterrupted switchover from AC power supply operation to emergency power supply operation and continue traveling to the next floor under full power.

High charging efficiency. Thus, the waiting time between recovery of the power supply and the return of the elevator to operating status is reduced to a fraction of what is required by a battery.

Service life several times longer than that of a battery.

No need to conduct energy storage unit maintenance.

Does not contain toxic or environmentally-harmful substances.

The dependent claims present beneficial designs and further design improvements.

When the device of the present invention is used to provide crossover during momentary AC voltage drops or interruptions and then to overcome the remaining distance to a floor during emergency operation, it is best to use an energy storage unit that includes a supercapacitor as its only storage medium. As for applications of the device of the present invention that entail the possibility of AC voltage power outages and require full-load, great-height emergency operations, it would be best to use an energy storage unit that consists of a combination of a supercapacitor and an electrochemical battery. This is because the latter has a greater energy density (Wh/kg) than a supercapacitor. In other words, it has a higher storage capacity at any given weight. Examples of the application conditions described above include "lobby" elevators that skip several floors without stopping or elevators in sightseeing towers that stop at only one or two floors high above the ground.

It is especially advantageous that the device of the present invention can be used in combination with driving device regulated by a frequency converter. Said frequency converter consists primarily of an AC rectifier, a DC intermediate circuit with filtering capacitor, and an oscillating converter. The oscillating converter feeds changing frequencies to the driving motor and thereby determines the rotating speed. In embodiments that do not have a rectifier for recovering braking energy, the DC intermediate circuit should be equipped with at least one braking module. The present invention's energy storage unit, which consists of either one supercapacitor or a supercapacitor-battery assembly, stores energy from said DC intermediate circuit and, when necessary, i.e. when used for emergency operation during an AC voltage drop or interruption or a power outage, outputs it to the DC intermediate circuit. Within this circuitry, there is a

regulating and control unit called a power flow governor, which is used to adapt the DC voltage levels of the energy storage unit and the intermediate circuit and for regulating energy exchange between the energy storage unit and the frequency converter.

A particular advantage that arises from the combination between the device of the present invention and the frequency converter that serves as a drive regulator is the fact that the electric energy fed from the DC intermediate circuit of the frequency converter can exercise control over elevator equipment, both in normal operating mode and in emergency power supply operating mode. Therefore, it can ensure a totally uninterrupted elevator control feed when the system switches from normal operating mode to emergency power supply mode. Moreover, it can reduce the need for power supply equipment that is generally used for control.

In multiple-elevator elevator systems, a single device can beneficially and economically serve as the emergency power supply device for the entire elevator set. In such a setup, power is fed to each driving motor by a common DC intermediate circuit via allocated oscillating converters. In multiple-elevator situations, not all elevator driving devices are operating simultaneously and with a full load. Moreover, generally, when driving motors for counterweighted elevators operate with less than half effective load, it is even possible to recover shared DC intermediate circuit braking energy. Thus, it is possible to reduce the required capacity of the energy storage unit to a fraction of the sum of all the capacities of the emergency power supply devices separately used by each elevator in the elevator set.

When employing an integrated driving system for elevator equipment used to operate one or more elevators, one should install a frequency converter, elevator control unit, and the emergency power supply device of the present invention on one or more elevator cabs and allow them to travel with the cabs. Then, by means of separate contacts or by means of a no-contact energy transmission system, one can provide a floating charge to the energy storage units on the elevator cabs. This method has the advantage of obviating the need to install energy feeding devices along the entire route of travel. This is a particularly important point in multiple vertical elevator shafts where the elevator cabs operate in alternating shafts (including elevator equipment that operates horizontally).

According to a preferred application of the present invention, the design of the energy storage unit and the power flow regulator allows the emergency power supply device of the present invention to be used not only to provide emergency operation during power outages but also to provide crossover in AC voltage drops and interruptions. In addition, it also aids in lowering the power supply connection power needed by the equipment. This point is realized through the following method: When the elevator stops operating or is in a low driving load phase, the energy storage unit stores energy, and in maximum load and above-average operating condition phases, it feeds energy back to the drive current circuit. The power flow regulator regulates the two-way energy flow in this setup. When, for example, the emergency power supply device of the present invention works in combination with a frequency converter, power is converted and

fed to the driving motor by means of said frequency converter. When the electric motor is in a below-average operating condition phase, the energy storage unit is charged by the DC intermediate circuit of the frequency converter. When it is in an above-average operating condition, the energy storage unit feeds back some of the stored energy to the DC intermediate circuit.

The present invention is further described below in light of the referenced attached drawings.

FIG. 1 is an illustration of the components of an elevator driving device. In it, an emergency power supply device of the present invention is joined to a frequency converter and includes a supercapacitor as the only energy storage medium.

FIG. 2 is an illustration of the components of an elevator driving device. In it, an emergency power supply device of the present invention is likewise joined to a frequency converter, and it includes a combination of a supercapacitor and a battery as the energy storage media.

FIG. 3 is an illustration of the components of an elevator driving device. In it, the emergency power supply device of the present invention is joined to a DC intermediate circuit shared by several frequency converters, and it includes an assembly consisting of a supercapacitor and a battery as the energy storage media.

FIG. 1 shows the main components of the elevator driving device that has a frequency converter and the emergency power supply device of the present invention. The frequency converter is indicated by 1. An AC power supply 2 feeds electricity to said frequency converter, which primarily consists of an AC rectifier 3, an oscillating converter 4, a DC intermediate circuit 5, a filter capacitor 6, a brake module 7 (having a brake resistor and a brake switch), and an electric motor cable 8. One AC motor 9, serving as the elevator driving motor, is connected to the frequency converter 1. The emergency power supply device is indicated by 10, which has an energy storage unit 11 (consisting of a supercapacitor 13) and a power flow regulator 12. The branch lines 17 connect the DC intermediate circuit 5 with the power supply for the electrical components 18 that must operate during an emergency, e.g. the elevator driving device, mechanically-driven brakes, door-driving devices, illumination devices, communication devices, and ventilation devices.

In normal operation mode, the AC rectifier 3 of the frequency converter 1 receives AC current from the power grid via the power supply line 2 and generates DC electricity from this AC electricity. Then, the DC electricity is fed to the DC intermediate circuit 5. The oscillating converter 4 receives DC current from the DC intermediate circuit 5 and, under the integrated control of a control generator, it generates frequency-converted AC current from DC current and feeds it to the AC motor 9. The generated AC frequency decides the rotating speed of this electric motor and thus decides the travel speed of the elevator. In this setup, the central elevator control unit continually and in a corresponding mode sends instructions on the proper travel speed at a specific time point to the control generator of the oscillating converter. The filter capacitor 6 suppresses voltage waves and peaks in the DC intermediate circuit.

Provided that the brake module is not used for recovering brake energy to the rectifier 3 in the power grid, and the rectifier 3 is not designed to recover brake energy for the power grid, the brake module 7 is used to take the brake energy generated by the AC motor 9 when it is operating under a negative motor load and convert it into heat. If the AC rectifier is not designed to recover brake energy for the power supply, another task of the brake module is to ensure the electrical braking capability of the AC motor 9 in the event of AC rectifier 3 failure. In this setup, the brake module is activated as soon as voltage in the DC intermediate circuit exceeds a certain value during braking. The power flow regulator 12 basically is a commercially available two-quadrant DC voltage stabilizer used for voltage polarity and two current directions. Its task is to control energy flow between different voltage levels in the DC intermediate circuit 5 and the energy storage unit 11. On the one hand, when there is a surplus of energy in the DC intermediate circuit 5 (as occurs when all elevator equipment is in a standby mode), the power flow regulator 5 provides a floating charge to the energy storage unit. On the other hand, the power flow regulator, when necessary, i.e. when a power outage or a momentary AC voltage drop or interruption occurs, the stored electrical energy is again fed to said DC intermediate circuit 5.

If a momentary voltage drop or interruption or a power outage occurs while the elevator is traveling, the DC intermediate circuit 5 (including the oscillating converter 4) and the components fed power by the branch line 17 that must perform during emergency operation must at least be able to receive a continuous supply of power until the elevator cab arrives at the next floor that has a shaft door. Therefore, the supercapacitor 13 of the energy storage unit 11 can, without the slightest delay, provide the maximum current needed for full-load operation and be fully recharged within the shortest possible time after power supply is restored. This point is especially advantageous in buildings where power outages occur frequently and in close succession. In contrast, a battery-based emergency power supply device must wait a relatively long period of time to recharge after an emergency operation. Thus, a relatively long period of time is needed after a battery-based power supply is restored before the elevator can work automatically. Otherwise, the elevator cab will risk becoming stuck between two floors should another power outage occur.

FIG. 2 shows an elevator driving device (described with reference to FIG. 1) that has a frequency converter 1 and the emergency power supply device 10 of the present invention. In this setup, the energy storage unit 11 consists of two different storage media. To provide crossover during momentary AC voltage drops or interruptions and to perform short-distance emergency operation, the energy storage unit 11 contains the supercapacitor 13 (whose beneficial properties were described above) as a storage medium. To enable the energy storage device 11 to provide adequate energy for emergency operations over longer distances, the energy storage device includes a battery 14, e.g. a lead or nickel-cadmium battery, as a supplementary energy storage medium. This type of battery 14 has a higher energy density (Wh/kg) than the supercapacitor 13. In other words, the battery can store more energy at any given weight. Although no

battery of significant size has a comparable response speed during high-level, rapid power consumption processes, and battery life is sharply reduced by the frequent occurrence of such incidents, in the combined energy storage media of the present invention it is the supercapacitor 13 that provides the peak power needed for crossover during frequent, momentary voltage drops and interruptions and for short-distance emergency operations, and the energy needed for longer emergency operations is provided by both storage media.

Therefore, while optimizing battery life, it is also possible to minimize the required total weight of the energy storage unit 11. Said energy storage unit 11, as described with reference to FIG. 1, is linked through the power flow regulator 12 to the DC intermediate circuit of the frequency converter. In this embodiment of the energy storage unit, the power flow regulator 12 should be controlled to obtain energy from the battery only during longer incidents. Again, for the components 18 that must perform during emergency operation, energy is always supplied without the slightest interruption via the branch lines 17 to the DC intermediate circuit 5.

FIG. 3 shows a configuration of a set of electrical components consisting of frequency converter-regulated elevator driving devices. In this configuration, there are several rotating electric motors 9 connected via attached oscillating converters 4 to a shared DC intermediate circuit 16. During normal operation, said DC intermediate circuit is supplied electric power by a single power supply module 15, and if, while the elevator is traveling, an AC voltage drop or interruption occurs or a total power failure occurs, power is supplied by the single emergency power supply device of the present invention. The emergency power supply device 10 in this embodiment consists of one energy storage unit 11 and one power flow regulator 12. The energy storage unit 11 either consists of only a supercapacitor or of the above-described supercapacitor and battery. The power flow regulator 12 has the same function that was described above. In addition, during power outages, it is necessary to supply power without the slightest interruption to the components that perform during emergency operation, such power being supplied from the shared DC intermediate circuit 16 via the branch lines 18. A first advantage of this multiple-driving device configuration is that it needs only a single power supply module 15. Said module preferably has the ability to feed surplus brake energy back to the power grid. (The use of low-power range single driving devices would generally be too expensive.) A second advantage is that, by means of the shared DC intermediate circuit 16, it can directly provide energy compensation between driving devices for driving and braking. In addition, it needs only a single emergency power supply device 10 of the present invention to replace multiple independent emergency power supplies. Therefore, it can greatly reduce hardware expenditures and thus reduce cost.

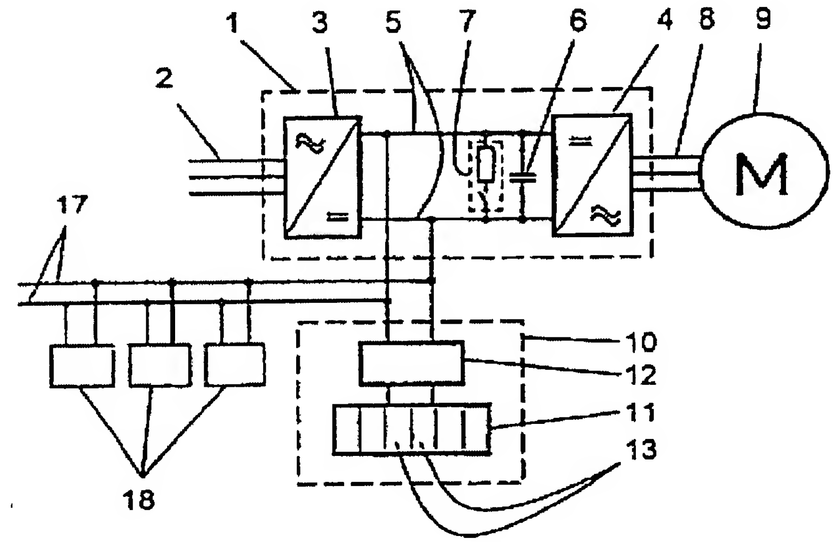


FIG. 1

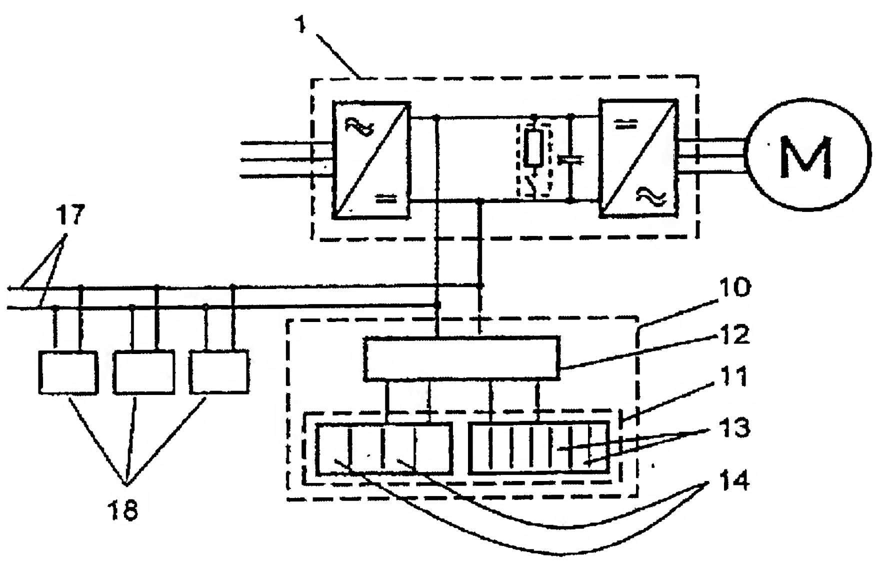


FIG. 2

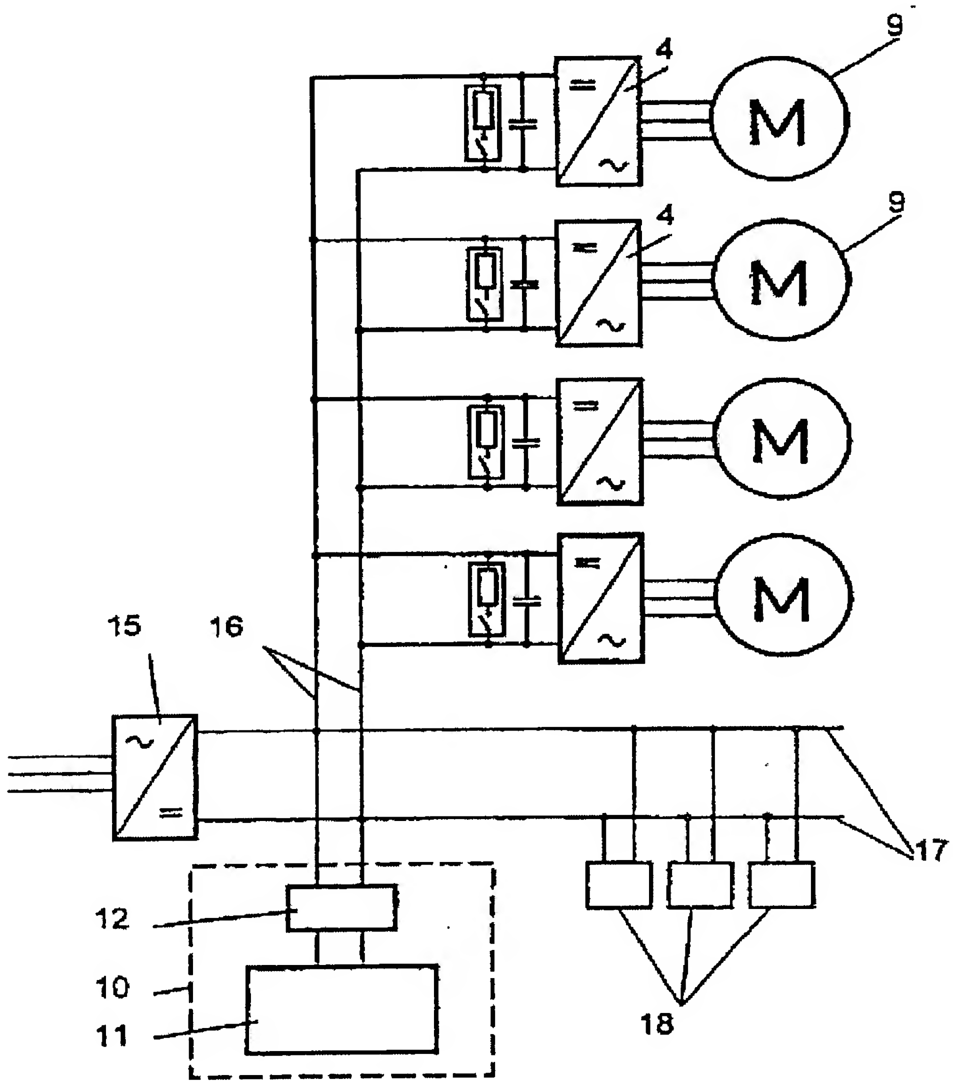


FIG. 3

[19] 中华人民共和国国家知识产权局

[51] Int. Cl^7
B66B 5/02

[12] 发明专利申请公开说明书

[21] 申请号 01807220.8

[43] 公开日 2003年5月21日

[11] 公开号 CN 1419518A

[22] 申请日 2001.3.21 [21] 申请号 01807220.8
[30] 优先权
[32] 2000. 3.31 [33] EP [31] 00810272.5
[86] 国际申请 PCT/CH01/00175 2001.3.21
[87] 国际公布 WO01/74703 德 2001.10.11
[85] 进入国家阶段日期 2002.9.26
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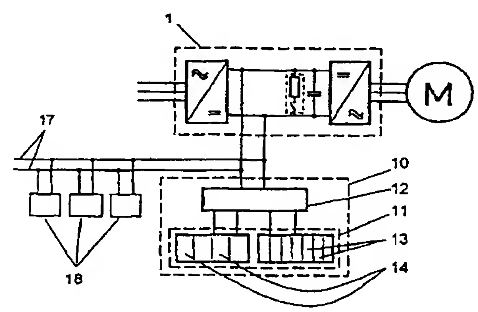
权利要求书2页 说明书7页 附图2页

[54] 发明名称 电梯设备的备用电源装置

[57] 摘要

用于具有电机驱动装置的电梯设备的备用电源装置的任务在于实现对短时间的交流电压—压降或—中断的跨接和保证在电梯运行时所有对疏散运行必要的电梯设备部件的供电，直至电梯轿厢到达一个楼层。为此采用的蓄能单元(11)作为存储媒体或者仅具有作为超电容(13)的电容器，或者具有一个由超电容(13)和电化学蓄电池(14)构成的组合。



ISSN 1008-4274

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1．一种用于具有电机驱动装置的电梯设备的备用电源装置（10），具有电能的蓄能单元，所述蓄能单元对所有参与疏散运行的电梯设备的电气部件至少在电梯轿厢到达一个楼层前进行供电，实现对短时间的交流电压-压降或-中断的跨接和保证在电梯运行时的疏散运行，其特征在于，蓄能单元（11）包含一个超电容（13）形式的电容器。

2．按照权利要求 1 所述的装置，其特征在于，作为存储媒体的蓄能单元（11）仅包含超电容（13）或包含超电容（13）与电化学蓄电池（14）的组合。

3．按照权利要求 1 或 2 所述的装置，其特征在于，所述装置与变频器（1）配合，利用变频器调节电梯的运行速度。

4．按照权利要求 3 所述的装置，其特征在于，由直流电压中间电路（5）对蓄能单元（11）浮充，并且该蓄能单元（11）在必要时将电能馈送给直流电压中间电路（5），其中一个连接在中间的功率通量调节器（12）对直流电压中间电路（5）与蓄能单元（11）之间的不同的电压水平进行调节。

5．按照权利要求 4 所述的装置，其特征在于，所述装置在停电时通过变频器的直流电压中间电路至少对起着保证充分疏散运行的那些电气部件提供备用电流，其中在正常运行时也由所述的直流电压中间电路（5）对这些部件（18）进行馈电。

6．一种对具有电机驱动装置的电梯设备应急供电的方法，采用该方法在电梯运行时当出现停电或出现短时间的交流电压-压降或-中断时至少在电梯轿厢到达一个楼层前对疏散运行重要的部件（18）进行供电，其特征在于，至少一部分备用电源-能量以超电容（13）的形式被存储在存储媒体中。

7．按照权利要求 6 所述的方法，其特征在于，在停电或短时间出现交流电压-压降或中断时备用电源装置（10）不间断地投入使用。

8．按照权利要求 6 或 7 所述的方法，其特征在于，用唯一一个备用电源装置（10）对多部电梯供电。

9．按照权利要求 6 或 7 所述的方法，其特征在于，备用电源装置（10）固定安装在建筑物内或安装在具有一体的驱动装置的电梯设备上，并随后者移动 。

10．按照权利要求 6 至 9 中任一项所述的方法，其特征在于，备用电源装置（10）具有一个蓄能单元（11），所述蓄能单元通过一个功率通量调节器（12）连续地与变频器（1）的直流电压中间电路（5）连接并且其设计应使其除了起着作为备用电源存储器的作用，在电梯正常工作时还用于减少电源连接功率，其中蓄能单元（11）在驱动系统低功耗阶段存储来自电网的能量、回收在制动过程中的能量并且在大功耗的情况下将能量输出给驱动系统。

电梯设备的备用电源装置

本发明涉及一种具有电机驱动装置的电梯设备的备用电源装置，所述备用电源装置具有一电能的蓄能单元，所述蓄能单元用于实现对短时间的交流电压-压降或-中断的跨接和保证在电梯运行期间停电时的疏散运行，其中蓄能单元至少在电梯轿厢到达一楼层高度前实现对所有参与疏散运行的电气部件的供电。

通常用电机对载人电梯和载货电梯进行驱动。其中可以采用对电梯轿厢的各种升力传递原理。最经常的实施方式是旋转电机直接或通过作用于主动轮的传动机构对承载索进行驱动，所述承载索的一端悬挂电梯轿厢并且另一端悬挂配重并对后者进行移动。在另一实施方式中旋转电机对一液压泵进行驱动，所述液压泵主要通过压力液体对一个或多个液压缸进行控制，所述液压缸直接地或通过缆索传动对电梯轿厢进行驱动。根据另一驱动原理，利用一线性电机对电梯轿厢或它的通过承载索与其连接的配重提升或下降。在现代的电梯设备中电梯轿厢的速度的调节大多通过对输送给驱动-交流电机的交流电流的频率的调节变化实现的。

通常所有这些驱动装置的共同点是由电源网获得能量，其中有时会出现短时间的电压压降或中断以及长时间的停电。在没有备用电源装置的电梯设备中这些电源问题将会对乘客造成不便。在这种情况下，电梯轿厢停在两个楼层的停靠点之间，该情况将导致没有电梯外的帮助乘客是不可能离开轿厢的，为了避免此类情况的发生，一部分电梯设备装备有备用电源装置。所述备用电源装置包括一个蓄能器，利用被存储的能量使驱动装置可以将电梯轿厢至少输送到下一楼层并使与电梯相关的系统在到达下一楼层前保持工作状态。

在 US 5，058，710 中披露了这样一种备用电源装置，该备用电源装置在电梯运行期间当出现停电或出现短时间的交流电压-压降或-中断时将对驱动电机以及对疏散运行重要的其它电气部件馈送电源，直至电梯轿厢

到达下一楼层。在正常工作时对作为蓄能单元的电池（蓄电池）用一充电器进行浮充，并且其电极在停电时通过电源监视继电器的触点与一对驱动电机馈电的变频器的直流电压中间电路连接。

作为单独的能量存储器的具有作为蓄电池的电化学蓄电池的备用电源装置具有如下几大缺点。应用时，即电梯驱动装置在停电时利用能量存储器必须不中断运行并且不减速地将满载的电梯轿厢至少输送到运行方向的下一个楼层时，能量存储器在相对较短的时间必须实现较大的放电功率。电化学蓄电池具有相对较小的功率密度（大约 300 瓦/公斤）并且在应用于大功率的电梯时其质量的量度将达到几百公斤。在蓄电池经常必须提供这种功率的设备中，蓄电池的寿命将被急剧地缩短。由于在蓄电池中允许的充电功率大大地小于输出功率，则将产生连锁的问题，当重新来电，电梯重新可以工作时，必须等待较长的时间进行充电。否则将存在电梯轿厢在再次停电时停在两个楼层之间的风险。在电梯设备中应用蓄电池的另一缺点是，必须对其定期监视和维护并且在达到其使用寿命时将会遗留下许多有毒的废物。

本发明的目的在于提出一种上面所述方式的可以避免所述缺点的电梯设备的备用电源装置，所述备用电源在比较频繁的出现停电和在出现短时间的交流电压-压降或-中断时能够提供以恒定速度使电梯轿厢继续向至少下一个楼层的运行为驱动和控制所需的大的电功率。在备用电源投入使用时在重新恢复供电后的几秒钟内备用电源应能处于可重新工作的状态。其寿命在相同的工作状况下应是电化学蓄电池寿命的几倍。

根据本发明采用独立权利要求 1 和 6 中给出的特征实现了本发明的目的。根据权利要求 1，一种用于具有电机驱动装置的电梯设备的备用电源装置具有电能的蓄能单元，其特征在于，所述蓄能单元包含一个超电容形式的电容器。根据权利要求 6，一种对具有电机驱动装置的电梯设备应急供电的方法，其特征在于，至少一部分备用电源-能量以超电容的形式被存储在存储媒体中。

本发明建立在如下构思的基础上：采用作为蓄能器的新型的电容器，即所谓的超电容替代蓄电池或与蓄电池组合在一起，其中通常将多个超电容串联在一起使用，串联的电容的总容量为几个法拉，电压可达几百伏。

超导电容是双层-电容器，采用活性炭对其电极进行涂附并因此每克炭具有几千平方米的有效表面，其中数量级为纳米的最小的间隔将两个电极分隔开。由于这些特性，因而这种可以购买到的蓄能器具有特别大的电容。

对作为电梯设备的备用电源装置的能量存储媒体的超电容的应用具有如下多个优点：

在大量的充电-和放电周期（目前超电容的功率密度大约为 10-15 千瓦/公斤；目前蓄电池的功率密度大约为 300-1000 瓦/公斤）。因此用一至少轻 10 倍的蓄能单元即可实现无间断的由交流电源工作向备用电源工作以及以满驱动功率向下一个楼层继续运行的切换。

充电效率高；因此将恢复供电与电梯处于可工作状态之间的等候时间缩短到是蓄电池所需时间的几分之一。

比蓄电池增大了几倍使用寿命。

不必对蓄能单元进行维护。

不含有有毒或对环境造成不利影响的物质。

在从属权利要求中给出有益的设计和进一步设计。

一方面本发明的装置用于跨接出现较短时间的交流电压-压降或-中断并且另一方面在疏散运行时仅需要克服剩余的楼层间隔，最好采用作为存储媒体的仅包含超电容的蓄能单元。对于那些存在交流电源停电的可能的必须用本发明的装置实现大的疏散高度的满载的疏散运行的应用，最好采用由超电容与电化学蓄电池（蓄电池）的组合构成的蓄能单元，这是因为后者与超电容相比具有的能量密度较高（Wh/kg），即在重量相同的情况下具有较高的存储容量。例如在那些所谓的大堂-电梯越过多个楼层间隔不停的电梯设备或在观光塔中仅以大高度差地驶抵一个或两个停靠楼层的电梯就是所述及的应用条件。

特别有益的是本发明的装置可以与变频器调节的驱动装置结合在一起使用。所述变频器主要由一交流电整流器、一个具有滤波电容器的直流电压中间电路，以及一个具有控制发生器的振动子换流器构成，其中该振动子换流器向驱动电机馈送变化的频率并以此决定转速。在不具有用于回收制动能量的交流整流器的实施方式中，应对直流电压中间电路装备至少一个制动模块。本发明的含有一个由超电容或由超电容与蓄电池组合构成的

蓄能单元的装置对来自所述直流电压中间电路的能量进行存储并且在必要时，即在出现交流电压-压降或-中断时以及在停电时用于疏散运行时输出给直流电压中间电路。其中一个被称作功率通量调节器的调节和控制单元用于对蓄能单元与中间电路的直流电压水平进行适配调节并用于在蓄能单元与变频器的中间电路的能量交换进行调节。

由此产生的本发明的装置与作为驱动调节器的变频器的组合的一个特殊的优点是，由变频器的直流电压中间电路的馈送可在正常工作方式时以及备用电源工作方式实现对电梯设备的控制。因此可以保证在由正常工作方式向备用电源工作方式转换时完全无间断的电梯控制馈送并且另外可以节省通常用于控制的电源设备。

在具有多部电梯的电梯设备中有益地并节省费用地可以为整个电梯组采用本发明的唯一一个装置作为备用电源装置，其中对每台驱动电机由一共用的直流电压中间电路通过一配属的振动子换流器进行馈电。由于在多部电梯的情况下并不是所有的电梯驱动装置同时地并且满载负荷的工作并且另一方面通常的具有配重的电梯的驱动电机在少于一半的有效负荷的情况下运行时甚至可以回收共用的直流电压中间电路的制动能，所以可以将蓄能单元的必要的容量减少到在电梯组的所有电梯分别采用单独的备用电源装置的所有容量总和的几分之一。

在采用一综合的驱动系统对一部或多部电梯运行的电梯设备中宜将变频器、电梯控制单元以及本发明的备用电源装置安装在一部或多部电梯轿厢上并随后者移动。然后可以分别通过接触件或利用无接触能量传输系统对电梯轿厢上的蓄能单元进行浮充。这种方法的优点是不必沿整个运行路径设置能量馈送装置，此点特别是对有多个电梯竖井并且电梯轿厢在交替的电梯竖井内运行的，其中也包括水平运行的电梯设备中是重要的。

根据本发明一优选的应用，蓄能单元和功率通量调节器的设计应使本发明的备用电源装置不仅用于在停电时实施疏散运行并用于跨接交流电压-压降和-中断，而且还有利于降低设备所需的电源连接功率。此点是通过如下方式实现的，蓄能单元在电梯停止运行时以及在低驱动负荷阶段对能量进行存储并且在最大负荷和超平均工作状况阶段重新将能量反馈给驱动电流电路，其中通过功率通量调节器对双向的能量通量进行调节。当例如

本发明的备用电源装置与一个变频器配合工作时，通过所述变频器变频地对驱动电机进行馈送，在低于平均电机工作状况阶段由该变频器的直流电压中间电路对蓄能单元充电，并且在超平均工作状况下蓄能单元将一部分被存储的能量重新反馈给该直流电压-中间电路。

下面将对照附图对本发明做进一步的说明。

图 1 为电梯驱动装置的部件的示意图，其中本发明的备用电源装置与一变频器配合并且仅包括作为蓄能媒体的超电容；

图 2 为电梯驱动装置的部件的示意图，其中本发明的备用电源装置同样与一变频器配合并且包括作为蓄能媒体的超电容与蓄电池构成的组合；

图 3 为电梯驱动装置组的部件的示意图，其中本发明的备用电源装置与多个变频器共用的直流电压中间电路配合并且包括作为蓄能媒体的超电容与蓄电池构成的组合。

在图 1 中示意示出一个具有变频器和本发明的备用电源装置的电梯驱动装置的主要部件。用 1 表示变频器，由交流电源 2 对该变频器馈电并主要由一交流整流器 3、一振动子换流器 4、一直流电压中间电路 5、一滤波电容器 6、一制动模块 7（具有制动电阻和制动工作开关）和一电机接线 8 构成。一台作为电梯驱动电机的交流电机 9 与变频器 1 连接。用 10 表示备用电源装置并且一方面具有一由超电容 13 构成的蓄能单元 11 并且另一方面具有一个功率通量调节器 12。支路 17 将直流电压中间电路 5 与对在疏散运行时必须起作用的诸如电梯驱动装置、机械驱动制动器、门驱动装置、照明装置、通信装置、通风装置等的电梯的电气部件 18 的电源连接。

在正常工作方式时，变频器 1 的交流整流器 3 通过电源接线 2 由电网中获得交流电流并由此交流电产生直流电，然后将直流电馈送给直流电压中间电路 5。振动子换流器 4 由该直流电压中间电路 5 获得直流电流并在一集成的控制发生器的控制下由直流电流产生变频的交流电流，向交流电机 9 馈送。所产生的交流频率决定该电机的转速并随之决定电梯的运行速度，其中中央电梯控制单元向振动子换流器的控制发生器以相应的方式连续地发送有关在一特定的时间点应产生的运行速度的信息。滤波电容器 6 对直流电压中间电路中的波动和峰值电压进行抑制。只要没有用于将该制

动能回收到电网内的交流整流器 3 和交流整流器 3 的设计不能用于将制动能回收到电网中，则制动模块 7 用于将由交流电机 9 在以负的电机负荷运行时产生的制动能转换成热能。在交流整流器的设计不能用于将制动能回收到电源中的情况下，制动模块的另一项任务是在交流整流器 3 失效时保证交流电机 9 的电气制动能力，其中一旦在制动时直流电压中间电路 5 中的电压超过一定的值时，制动模块被激活。功率通量调节器 12 基本上是一个市售的用于电压极性和两个电流方向的 2-象限（Quadranten）-直流电压稳压器，其任务在于对直流电压中间电路 5 和蓄能单元 11 中的不同的电压水平之间的能量通量进行控制。一方面在电梯设备整个处于待机状态时当直流电压中间电路 5 中的能量过剩时通过功率通量调节器 5 对能量存储单元进行浮充，另一方面功率通量调节器在必要时，即出现短时间的交流电压-压降或-中断和停电时，重新将存储的电能反馈给所述的直流电压中间电路 5。

当电梯运行期间出现短时间的交流电压-压降或-中断以及在停电时，直流电压中间电路 5 和随之也包括振动子换流器 4 以及通过支路 17 被馈电的必须在疏散运行时起作用的部件必须至少在电梯轿厢到达具有竖井门的下一个楼层前实现不间断的供电。蓄能单元 11 的超电容 13 因此可以毫不迟延地提供满载运行所需的最大电流并且在恢复供电后在最短的时间内重新被完全充电。此点特别是在经常出现并且紧接着连续出现停电的大楼内是特别有益的。在建立在蓄电池为基础的备用电源装置中，则与上述相反，在疏散运行后必须等待较长的重新充电时间，直至恢复供电后电梯可以自动工作。否则将存在当重新停电时电梯轿厢被卡在两个楼层之间的风险。

图 2 示意示出一个针对图 1 所述的具有变频器 1 以及本发明的备用电源装置 10 的电梯驱动装置，其中蓄能单元 11 由两种不同的存储媒体构成。为了满足在对短时间的交流电压-压降或-中断跨接，以及为了实现短距离的疏散运行，蓄能单元 11 包含作为存储媒体的具有上述有益性能的超电容 13。为了使蓄能单元 11 也可以为较长距离的疏散运行提供充足的能量，蓄能单元作为附加的存储媒体包括蓄电池 14（蓄电池），例如铅-或镍-镉-蓄电池。这种蓄电池 14 与超电容 13 相比具有较高的能量密度（Wh/kg），

即在重量相同的情况下蓄电池可以储存更多的能量。虽然蓄电池在有意义的规格的情况下还不具有在大功耗的快速过程中相同的反应速度，并且其使用寿命会因频繁地出现这种事件，而急剧缩短。在本发明的能量存储媒体组合中经常出现的短时间需要的用于跨接短时间的交流电压-压降和-中断并用于短距离的疏散运行的峰值功率是由超电容 13 获得的，并且用于长时间的疏散运行所需的能量将从两个存储媒体获得。

由此可以在寿命最佳的同时实现蓄能单元 11 的最佳的低的必要的总重量。所述的蓄能单元 11 以与针对图 1 的说明相同的方式通过功率通量调节器 12 与变频器的直流电压中间电路配合，其中在蓄能单元的实施方式中对功率通量调节器 12 的控制应实现仅对较长时间的事件从蓄电池获取能量。对必须在疏散运行时起作用的部件 18 在此也是通过支路 17 在任何情况下毫不间断地对直流电压中间电路 5 供给能量。

图 3 示出了由变频器调节的电梯驱动装置的一组电气部件的设置，其中有多台旋转电机 9 通过配合的振动子换流器 4 接在共用的直流电压中间电路 16 上，所述直流电压中间电路在正常工作时由一唯一的电源模块 15 供电并且在电梯运行期间当出现交流电压-压降和-中断时以及在完全停电时通过唯一一个本发明的备用电源装置供电。备用电源装置 10 在此也由一个蓄能单元 11 和一个功率通量调节器 12 构成，其中蓄能单元 11 或者仅由超电容或者由上述的超电容和蓄电池构成。功率通量调节器 12 具有与上述的描述相同的功能。而且在停电时必须对在疏散运行时起作用的部件 18 由共用的直流电压中间电路 16 通过支路 18 毫不间断地供电。这种对驱动装置的多重设置的第一个优点在于，仅需要唯一一个电源模块 15，该模块优选具有将过剩的制动能反馈回电源网络的能力（采用低功率范围的单个的驱动装置通常过于昂贵）。第二个优点是，通过共用的直流电压中间电路 16 可以直接进行在驱动的和制动的驱动装置之间的能量补偿。另外，仅需要唯一一个本发明的备用电源装置 10 取代了多个单独的备用电源装置，因而可以大大减少硬件的开销并随之降低成本。

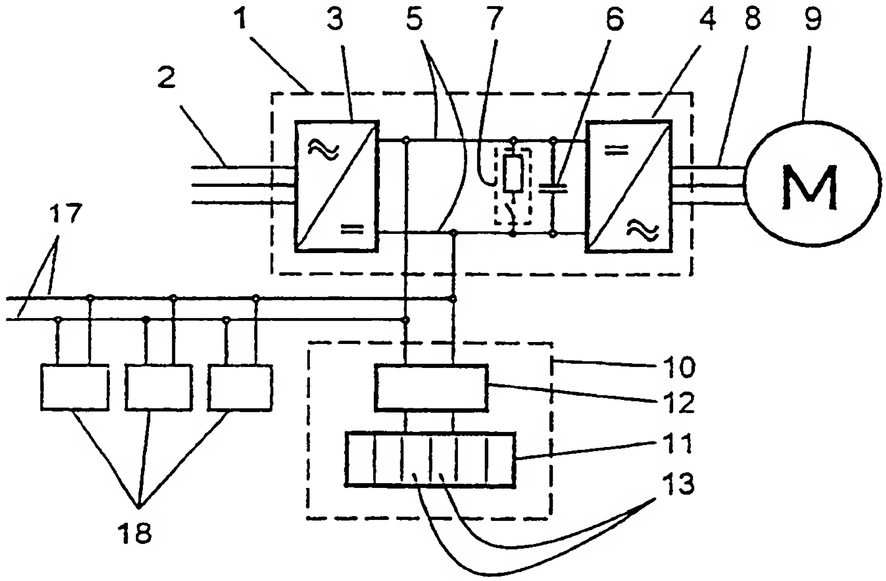

图 1

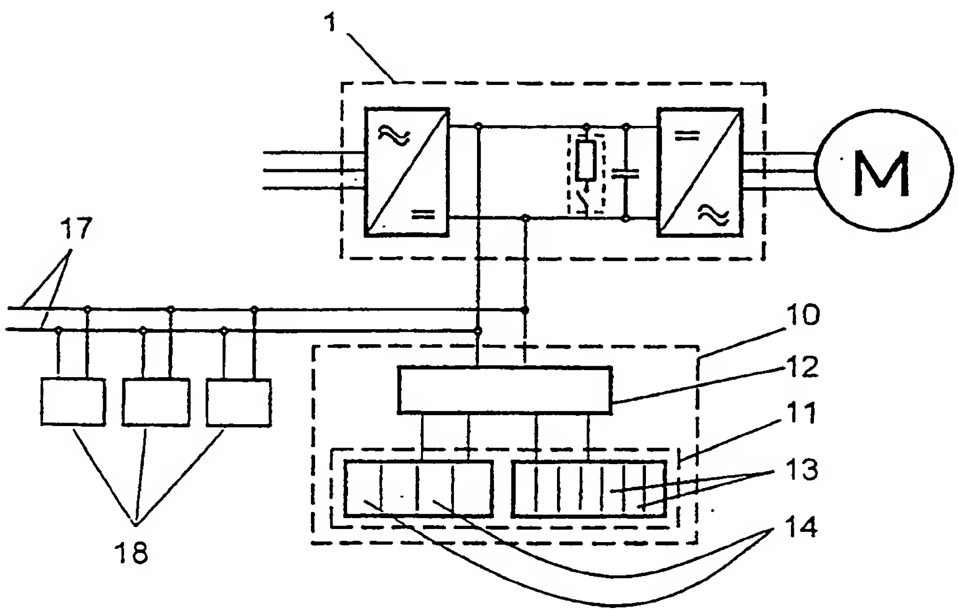

图 2

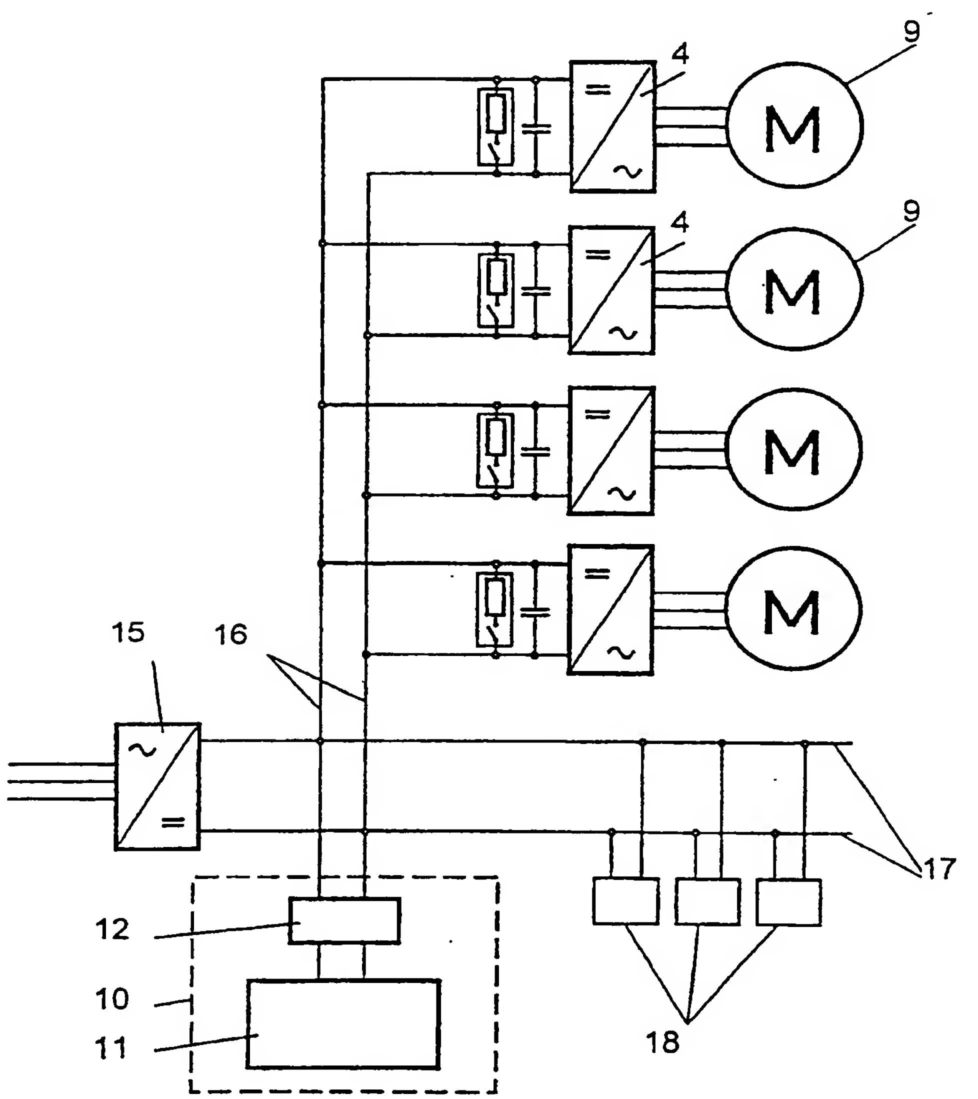

图 3